***Canada’s Greatest Natural Disaster?***

**Portal: Interactions and Associations**

Critical Challenge

Critical Tasks

Judge which Canadian natural disaster had the greatest negative impact.

Introduction/hook: A new edition of the Guinness Book of World Records: Canadian Edition is being published. They have been searching for someone to complete the final and best page of the book: The Greatest Canadian Natural Disaster. They think you are that person!

Task: Design to Spec:

Students will create a proposal that will use criteria based decision making to show that this event is worthy of inclusion in this publication. Must be persuasive.

Students will also create a ½ to 1 page entry for the Canadian edition of the Guinness Book of World Records that is engaging.

Overview

In this 3-part challenge students will be analyzing the ways in which natural systems interact with human systems and the short and long term impacts of these interactions. After researching different Canadian natural disasters, students will be asked to rank the different disasters in terms of breadth, depth and duration, and decide which is the greatest Canadian natural disaster. By working through the decision making matrix and a ranking system students will be able to build group consensus and produce two items: 1) a proposal for the publishing company and 2) Guinness Book of World Records entry that persuades people to see why their chosen natural disaster is the greatest in Canadian history.

- maybe they should “storyboard” their chosen natural disaster for a Canadian-made natural disaster movie??

**Objectives**

**Broad Understanding**

Students gain an understanding of the ways in which natural systems interact with human systems and the short and long term impacts of these interactions. They will understand that the interactions between these two systems shape and influence the other over time and space. Students will be able to study the result of these interactions in terms of breadth, depth and duration.

**Requisite tools**

*Background knowledge*

* Connections between natural and human systems
* Vocabulary (processes in climate and physical geography)

*Criteria for judgement*

Criteria for proposal – greatest impact

Depth

Breadth

Duration

Criteria for an Guinness World Book of Records Entry

engaging

Factual, relevant, informative

*Critical thinking vocabulary*

**Criteria**: a set of standards, rules or tests by which something can be measured or judged.

*Thinking strategies*

* Placemat
* Natural Disaster Decision Making Matrix blackline master
* Greatest Canadian Natural Disaster Decision Making Matrix blackline master
* The Greatest Canadian Natural Disaster Proposal blackline master

Habits of Mind

Attentive to detail: is careful in attending to detail.

Critically minded: is willing to evaluate information when it is important to do so

Respectful: is willing to engage respectfully in discussion with others

**Empathic?**

**Suggested Activitives**

**Pre-planning**

* prepare packages for a variety of Canadian natural disasters
* photocopy blackline masters
* prepare clips of two different disaster movies (e.g. Day After Tomorrow, Dante’s Peak, Twister, etc)

**Session One**

|  |  |
| --- | --- |
| **In this section, students will:** | **Instructions to the teacher** |
| *Be introduced to the concepts of Interactions and Associations* | Invite students to consider the following:  *A series of massive earthquakes of a magnitudes of over 7.3 struck the Pacific Ocean in October 2009. Although Tsunami warnings were issued, there were reports of only minimal damage. The earthquake occurred at a depth of 35km below the surface.*  Ask students whether they would classify this earthquake, “a natural disaser”.  Invite students to work with a partner to brainstorm the answer to the following question: What makes a natural event a disaster? Have students share as a whole class and record answers on the board.  Sample student answers might include:  - many people are killed or injured  - buildings are destroyed  - it’s expensive to clean up or rebuild  - wildlife is harmed  Suggest that the students are referring to the effects of the event and that when geographers consider how environmental and human factors influence each other, they are working with the concepts of **interactions and associations**.  Explain that during this lesson students will be working to develop this aspect of geographic thinking by examining natural disasters. |
| *Activating prior knowledge* | Suggest that when students were brainstorming what made an event a natural disaster, they were pointing out specific indicators of the *impact* of an event. These indicators will be useful but they might apply to some natural events but not to others. However, there might be broad **criteria** that we can apply to judge all natural disasters.  Define criteria as the set of standards, rules or tests by which something can be measured or judged. |
| *Uncovering criteria for greatest impact* | Suggest that one way to develop criteria for the magnitude of impact is to think to compare two similar disasters and discern what factors make one worse than another.  Provide students with statistics about 2 earthquakes that happened in 2010, one in Chile and one in Haiti (BLM #1: Comparing Disasters: Chile vs. Haiti, 2010).  Invite students to work with a partner to decide which earthquake had the greater impact. Ask students to share their responses with the class but encourage them to try to justify their choice without simply repeating the indicators provided.  As students explain their reasons for selecting the greater natural disaster, draw out the criteria for magnitude:  Something has a significant impact if there is:   * **depth of impact** – i.e. the effects of the impact are deeply felt or profound rather than superficial * **breadth of impact** – i.e. the effects of the impact are widespread (e.g. effects many people, a wide spectrum of people or many sectors of society or many aspects of the environment) * **duration of impact** – i.e. the effects of impact are long-lasting rather than short-lived   Consider posting this criteria on the wall for future reference. |
| *Practice using criteria to make a judgement* | Prepare clips from two Hollywood movies that depict natural disasters (see Teacher Backgrounder #1 for ideas). Indicate that the next activity does not assume that the clips that they are about to watch are accurate in their portrayal of the effects of a natural disaster – we could assess this as a seperate challenge. Rather, he purpose of the next activity is to practice applying our criteria.    Hand out the Natural Disaster Decision Making Matrix (BLM #2). As a pre-reading strategy, ask students to think to themselves about the second column. What might the criteria “look” like in the movies? Invite them to share their answers with the class and work collectively to fill in a list of possible indicators in the second column.  Show the clips of the two movies and have students take notes using the criteria of breadth, depth and duration. (Alternatively, you might consider modeling the use of the graphic organizer by completing it along with the first clip as a class and then inviting them to independently complete it while watching the second clip.)  At the end of the two clips have students complete the bottom of the blackline master to justify which of the two movies is the biggest natural disaster. Have students share answers with the class to ensure understanding of the criteria.  **Opportunity for differentiation:**   * *Consider allowing some students to select the movies and clips to be viewed.* * *You may wish to pre-teach technical vocabulary or provide a glossary for some students to support their viewing.* |
| *Transition to independent practice* | Invite students to think of other situations in geography where they might try tro determine what had the greater impact. Ask them to share their answers with a partner and then with the class. Sample student responses might include:  - examining the impact of different solutions to an environmental problem – e.g. different green energy solutions  - examining the impact of a changing landuse – e.g. building a road, expanding residential areas, losing agricultural land  - examining the impact of different steps individuals can take to reduce their ecological footprint  Invite students to summarize in their own minds, the steps they would use next time when trying to figure out the purpose and intended audience of a map.  Ask them to share their ideas with a partner.  Considering capturing their ideas as a series of steps and posting these steps on the wall for future reference. For example, a summary of their thinking strategies might include:  - Review the criteria for magnitude of impact (breadth, depth, duration)  - Select and sort evidence (from a reading, video clip, etc.) that is relevant for each criterion  - Look at all the evidence you have recorded and do an overall assessment of the impact  - Compare your overall assessment of one event, phenomenon, solution, etc. with your assessment of others to decide which has (or would have) the greatest impact  Inform students that they will be practicing what they have learned about determining the impact of different interactions and associations by looking closely at various Canadian natural disasters. |

**Session two**

|  |  |
| --- | --- |
| **In this section, students will:** | **Instructions to the teacher** |
| *Be introduced to the critical challenge* | Explain to students that over the next two days that they will be researching various Canadian natural disasters and deciding on the Greatest Canadian Natural Disaster. “Hook” the students by sharing with them the following: *A new edition of the Guinness Book of World Records: Canadian Edition is being published. They have been searching for someone to complete the final and best page of the book: The Greatest Canadian Natural Disaster. They think you are that person!* |
| *Research the options* | Invite students to work in groups of 4. Assign each group member a different natural disaster to research. Some options might include:   * Red River Flood, Manitoba (1997) * Ice Storm, Ontario, Quebec, New Brunswick (1998) * Tsunami, British Columbia (1964) * Hurricane Hazel, Ontario (1954) * Tornado, Ontario (1985) * Earthquake, British Columbia (1946)   Backgrounder Sheets are provided for each of these disasters but you may wish to focus on other Canadian natural disasters.  **Opportunity for differentiation:**   * *Consider grouping students intentionally according to their ability level (mixed or similar ability groupings).* * *Consider providing resources at varying reading levels according to the needs of students.* * *You may wish to pre-teach vocabulary or provide a glossary sheet for some students.* * *You may wish to pair students from two different groups to complete their particular reading together.* * *Each group might only compare 2 disasters with pairs working together on 1.* * *Students looking for a greater challenge might:* * *examine more than 1 disaster* * *read information at a more advanced reading level* * *examine different text forms (e.g. statistics)*   Provide each group member with the relevant reading. Invite students to use a during-reading strategy to help them pick out relevant information. For example, ask them colour code each of the criterion listed on their organizer (breadth, duration and depth of impact). While they read, invite them to mark the text (highlight or underline) in the relevant colour as they come across evidence that might be applied to one of the criterion.  Ask students to record their findings in their column of the Greatest Canadian Natural Disaster Decision Making Matrix (BLM #4).  **Assessment for learning**  *Assess individual student work before they share their findings with their group to check for understanding.* |
| *Share information* | Once students have completed their disaster’s portion of the matrix have them meet in with their group and share information to fill in any gaps they may have. Have the students number themselves off so they can be placed in heterogeneous groups to complete the rest of the decision making matrix. |
| *Ranking the options* | Once students have shared information on their individual disasters, invite students to work together to build consensus and rank each of the disasters in terms of impact using the impact rating scale below the chart (0 being no impact and 5 being devastating impact). Once consensus is achieved have the students add the rankings to discover which Canadian natural disaster they believe to be the most devastating. Individually students are to write a short response that justifies their choice. Remind students to use correct terminology.  **Assessment for learning**  *Assess individual student understanding before proceeding to the next step. This might include:*   * *having students participate in a 4 corners activity where they move to the sign on the wall that matches the disaster they think was the worst; have students talk in pairs and circulate to hear their discussion* * *ask students to summarize their conclusion and explanation on a cue card and submit it as their “ticket out the door”* * *examining each blackline master to check for understanding* |

**Session three**

|  |  |
| --- | --- |
| **In this section, students will:** | **Instructions to the teacher** |
| *Consolidate and apply learning* | Using the Greatest Canadian Natural Disaster Proposal blackline master have the students outline the points they would like to include in their Guinness World Book of Records Canadian Edition entry and write a proposal to the Publishing Company justifying why their entry should be included in the book. |
| *Setting criteria for the final task* | As a class discussion set the criteria for “engaging”. These could include but are not limited to: factual, persuasive, relevant, accurate, eye-catching. |
| *Complete the task* | Ask the students to complete the final part of this task: the Guinness World Book of Records Canadian Edition entry. Make sure they use the criteria set by the class. They can use information from class plus any additional information they research. This can be evaluated using the Evaulation Tool blackline master. |
| *Nurturing self-regulated thinking* | Consider gradually releasing responsibility to students for selecting the thinking strategies that would be most helpful when they determine the impact of various events, phenomena or interactions as the course progresses.  Initially, you might require or encourage students to use various thinking strategies they have been introduced to here.  As time progresses and students become more adept at using these thinking strategies, consider moving them toward self-regulated thinking by encouraging them to select which thinking strategies might be most useful when faced with similar challenges. |

**Assessment for learning**

*Assess each of the blackline masters prior to the students completing the Greatest Canadian Natural Disaster Proposal. This will ensure understanding of both the new vocabulary and that the students have obtained enough information to complete the task.*

**Assessment of learning**

Use the Evaluation Tool blackline master to evaluate the final Guiness World Book Canadian Edition entry.

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Blackline Master #1

**Comparing Disasters: Chile vs. Haiti, 2010**

|  |  |  |
| --- | --- | --- |
| **Indicator** | **Haiti** | **Chile** |
| **Magnitude of earthquake** | 7.0 | 8.8 |
| **Number of times stronger the Chile earthquake was than the Haiti earthquake** | 500 | |
| **Number of deaths** | more than 200,000 | more than 795 |
| **Number of buildings destroyed, according to country's president** | * 280,000 | * 500,000 |
| **Days consumed dealing with construction permits to build a basic warehouse** | * 1,179 days | * 155 days |
| **Ranking on worldwide corruption index** | * 168 | * 25 |
| **Hours before impacted country's president made first post-quake address** | * 168 | * 2 |
| **Hours before country accepted foreign assistance** | * 0 | * 48 |
| **Pace of World Vision US aid** | $3.9 million in first 48 hours, or $81,250 per hour | $220,000 in first 48 hours, or $4,583 per hour |
| **Number of news articles within first 48 hours of earthquake** | * 2,596 | * 400 |
| **Citizen’s average annual income** | * $1,300 | * $14,700 |
| **Population** | * 9 million | * 16 million |
| **Percentage of population below poverty line** | * 80 | * 18.2 |
| **Life expectancy** | * 61 | * 77 |

(Sources: CIA Factbook, International Finance Corporation, US Census Bureau, Wire services)

Adapted from: Chile earthquake facts: Chile vs. Haiti, in numbers. <http://www.csmonitor.com/World/Global-News/2010/0302/Chile-earthquake-facts-Chile-vs.-Haiti-in-numbers>

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Teacher Backgrounder #1

**Possible Movie Clips of Natural Disasters**

**Clips for Dante’s Peak**

Dante’s Peak Part 3 - YouTube: <http://www.youtube.com/watch?v=SCwZBUIX4pA&NR=1>

Show 35 sec to 5 min 55 sec. It gives background information on the town and volcanoes in general.

Dante’s Peak Part 6- YouTube:

1 min 25 sec going until 3min 55 sec. The clip provides some of the indicators for a volcanic eruption.

6 min 20 sec going until 10:00. Shows the beginning of the volcano activity and people’s reaction.

Dante’s Peak part 7 - YouTube: http://www.youtube.com/watch?v=Qn7sObVZNhE&NR=1

Shows the town in reaction to the volcano.

Dante’s Peak part 9 - YouTube: http://www.youtube.com/watch?v=YvBLRPHLC8Y&feature=related

7 min 10 sec to the end 11 min. Shows the actual explosion

**Twister Clips**

Twister (1/12) - YouTube - http://www.youtube.com/watch?v=-vWfBQMgIg8

1 min 25 sec to 5 min 45 sec. Shows a past tornado and talks about the possibility of multiple tornados happening.

Twister (4/12) - YouTube: http://www.youtube.com/watch?v=Gg-8nT3hkBc

2min 60 sec to 5 min 20 sec. Following a twister

Twister (5/12)- YouTube - http://www.youtube.com/watch?v=UDVU8BaBWTg&NR=1

45 sec to 5min 50 sec. Shows the main characters chasing multiple twisters and getting caught in the middle of one.

Twister (8/12) - YouTube - http://www.youtube.com/watch?v=zSL7GklU6TI&NR=1

3 min 20 sec to 9min 23 sec. Clip of a twister coming and people having to respond as well as the amount of damage that it can do.

Twister (9/12) - YouTube -http://[www.youtube.com/watch?v=gl7aGPepIDM&NR=1](http://www.youtube.com/watch?v=gl7aGPepIDM&NR=1)

2min 45 sec to 7min 45 sec. Shows the aftermath of a major tornado

Twister (11/12) - YouTube - <http://www.youtube.com/watch?v=ERmcJQnvEmM&NR=1>

Shows an F5 tornado.

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Blackline Master #2

**Natural Disaster Decision Making Matrix**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Indicators**  What would each criterion “look like”? | **Dante’s Peak**  Evidence of each criterion | **Twister**  Evidence of each criterion |
| Breadth of Impact How widespread are the effects of the phenomenon? |  |  |  |
| **Duration of Impact**  How long lasting are its effects? |  |  |  |
| **Depth of Impact**  How profoundly does the phenomenon affect the area where it occurs? |  |  |  |

**Conclusion:** The greater disaster is depicted in the movie: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Explanation:** Referring to the criteria and the evidence, explain your decision.

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Blackline Master #3

**Greatest Canadian Natural Disaster Decision Making Matrix**

In each box, record evidence from the reading(s). In the small boxes, assign a score from 1 to 5 based on the degree of impact the effects had.

**0 1 2 3 4 5**

**No Impact --- Insignificant Impact --- Limited Impact --- Moderate impact --- Significant impact --- Devastating Impact**

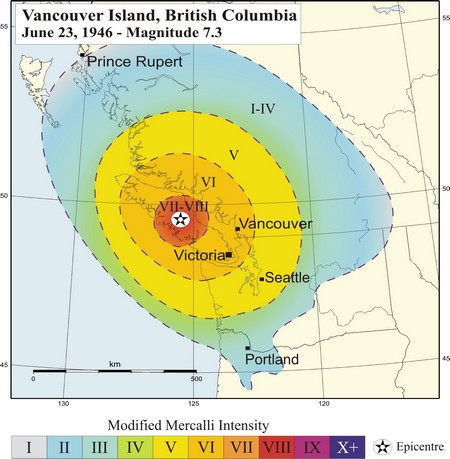
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Disaster:** | **Disaster:** | **Disaster:** | **Disaster:** |
| Breadth of Impact How widespread were the effects of the phenomenon? |  |  |  |  |
| **Duration of Impact**  How long lasting were its effects? |  |  |  |  |
| **Depth of Impact**  How profoundly did the phenomenon affect the area where it occured? |  |  |  |  |
| **Total Score** |  |  |  |  |

**Conclusion and Explanation:**

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Background Information Sheet #1

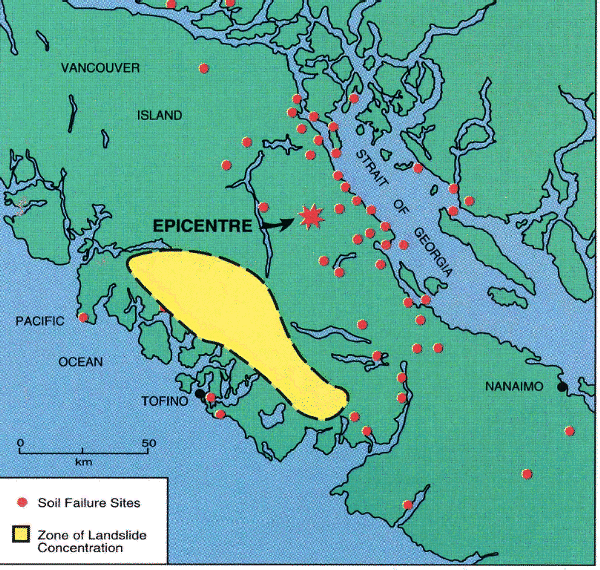
**Earthquake - British Columbia, 1946**

On Sunday June 23, 1946 Vancouver Island was hit with the strongest ever recorded earthquake on land in Canada, a magnitude 7.3 at 10:13 am. The epicentre, or point where the earthquake originated, was in the Forbidden Plateau area of central Vancouver Island, which is a small, hilly plateau in the east of the Vancouver Island Ranges. The gently sloping subalpine terrain is broken by small, rugged hills and pitted with small lakes. The town of Courtenay, located east of the epicentre, was directly impacted by the earthquake. In addition, tremors were felt as far north as Prince Rupert, British Columbia, and as far south as Portland, Oregon.



**Source: Natural Resources Canada**

Some of the areas that suffered damage were not near the epicentre. Coastlines and islands experienced damage even though they were not near the Forbidden Plateau because the unsteady nature of the soil, composed of clay and sand, caused liquefaction and amplification. Liquefaction refers to the loss of shearing resistance or the development of excessive strains resulting from transient or repeated disturbances of saturated cohesionless soils. Liquefaction-induced horizontal ground movements can range from minor oscillations during ground shaking with no permanent displacement, to small permanent displacements, to lateral spreading and flow slides. Amplification of ground motion due to subsurface and/or topographic conditions at a site is considered to be a seismic hazard over and above the firm ground seismic motions of the area. Amplification of ground motion often occurs at sites overlain by thick, soft soil deposits, especially when the predominant period of the earthquake motions matches the predominant period of the ground. In addition, the steep slopes of the Coastal Mountains resulted in several landslides.



**Map of central Vancouver Island showing locations of soil failures and landslide concentration. (Adapted from the Canadian Geotechnical Journal 1980, volume 17, page 124 and Bulletin of the Seismological Society of America 1979, volume 69, page 446).**

Although the 1946 earthquake was very destructive, there were only two casualties. In the areas affected the population was low and most of the buildings were built of wood. There were very few bridges and dams built at the time and most of the damage was done to chimneys that shook loose and crumbled. More than 75% of the chimneys in the area were affected.



**Chimney Damage, Port Alberni 1946 Earthquake**

**Source: Natural Resources Canada**

The damage in Vancouver, consisted of lofty buildings oscillating violently, and a piece of masonry fell from the local railway station. In addition, within the city, at least one gas line cracked and several power outages occurred. Fires broke out in several chimneys, and at least one [swing span bridge](http://en.wikipedia.org/w/index.php?title=Swing_span_bridge&action=edit&redlink=1) was fractured by the shaking. In the Hotel Vancouver, which housed the elderly and caught on fire, more than 500 war veterans' families fled the flames.



**Comox House Failure 1946 Earthquake**

**Source: Natural Resources Canada**

Larger structures in the downtown area of Courtenay suffered damage. The chimney at an elementary school collapsed but fortunately the earthquake hit on a sunday so the school was empty. Bricks fell off the rooftop of the post office building and some of the homes built on weaker foundations were shifted.



**Soiol Failure, Kelsey Bay Highway 1946 Earthquake**

**Source: Natural Resources Canada**

Neighboring towns of Powell River, Port Alberni and Union Bay also suffered damage. Bricks fell from the bank building in Port Alberni. The pavement in some parts of the Island Highway shifted or broke loose. Lighthouses along the waterways experienced shattered windows and seven-foot high tsunami rolled onto Texada Island in the Straights of Georgia.

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Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Background Information Sheet #2

**Tornado – Barrie, Ontario, 1985**

The 1985 Barrie tornado was one of the most destructive tornadoes in Ontario history. It is often described as the Hopeville to Barrie tornado which describes the path the twister took. A tornado is "an intense rotatory storm of small diameter characterized by at least one vortex reaching the earth's surface from a thunderstorm". In total, 13 separate tornadoes, with two of them rated at F4 on the Fujita Scale, a scale for rating [tornado](http://en.wikipedia.org/wiki/Tornado) intensity based on the damage tornadoes inflict on human-built structures and vegetation ranging from 0-5, crossed southern Ontario during the late afternoon and early evening hours of May 31, 1985.

**May 31, 1985, Barrie, Canada - Tornado**

**Source: National Severe Storms Laboratory**

A tornado swarm that hit Pennsylvania, Ohio, New York, and Southern Ontario struck Barrie, Ontario on May 1985. Southern Ontario was experiencing mild spring temperatures, while at the same time a storm front was moving across the midwest states in the United States heading for the Great Lakes. There was an area of warm air pushing ahead of the storm which encountered humid air off the Great Lakes, causing severe thunderstorms that produced wind shear, which a a dramatic change in wind speed and or direction within a short distance. By late morning the storms had ceased and the sun was shining pushing temperatures into the high 20s Celsius. Just behind the storm front was a mass of cool air that reached the Great Lakes around noon which resulted int he formation of more thunderstorms over Lake Huron by early afternoon headed towards Ontario. This resulted in the formation of three super cells which created tornadoes in several areas before reaching Barrie, Ontario.

**Tornado Damage in Barrie**

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**Source: The Barrie Banner Newspaper**

The first super cell resulted in a F2 tornado just north of Wiarton. Two more were detected near Clinton and further north in Walkerton. The northern super cell resulted in several tornadoes including an F3 in Dufferin County in Hopeville. Other notable touchdowns happened in Angus, Alliston, Corbetton, Mansfield and Terra Nova.

The southern super cell formed tornadoes in Arthur, Orangeville and Grand Valley; killing 2 people in Grand Valley and 2 people in Tottenham.

Two hours later a tornado went through Lindsey to Madoc in eastern Ontario and an F3 hit between Alma and Hillsburgh.

The Northern super cell hit Barrie with F4 force. At 4:30 in the afternoon the tornado hit the main transformer in the southwest side of the city cutting off all power to Barrie. In the southern part of Barrie the tornado struck a housing subdivision killing 3 people, then an industrial area where one person was killed. It crossed highway 400 picking up cars and tossing them in every direction.

Overall in Ontario 12 people were killed, hundreds were injured, 300 homes were destroyed, 800 people were left homeless and $100 million dollars in damage was caused.

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Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Background Information Sheet #3

**Hurricane Hazel – Southern Ontario, 1954**

Hurricane Hazel was first identified on the afternoon of October 5, 1954 50 miles east off the Island of Grenada, after traveling more than 10 days and causing enormous amounts of damage along its route it finally reached Canada on October 15, 1954. It was the deadliest and costliest hurricane of the 1954 Atlantic hurricane season. The storm killed as many as 1,000 people in Haiti before striking the United States near the border between North and South Carolina, as a Category 4 hurricane. After causing 95 fatalities in the US, Hazel struck Canada as an extratropical storm, raising the death toll by 81 people, mostly in Toronto.

Hurricane Hazel pounded the city of Toronto with 110 km/hr winds and more than 200 millimetres of rain in less than 24 hours. Bridges and streets were washed out, homes and trailers were washed into Lake Ontario. Thousands were left homeless, and 81 were killed – 35 of them on one street alone.

**Damage from Hurricane Hazel- Toronto,1954**



**Source: Environment Canada**



**Source: Environment Canada**

In the weeks leading up to Hazel’s arrival the Greater Toronto Area had received a higher than normal amount of rainfall saturating the water table even before Hurricane hazel rained down on the area. It is estimated that more than 90% of the precipitation from Hazel just ran off into the rivers and creeks in Toronto raising water levels up to eight metres. The areas east of Toronto, Snelgrove and Brampton received the most rain of any Canadian location. Anything built in the floodplain of a major waterway was either inundated or simply swept away. Not built to withstand heavy flooding, Toronto's infrastructure took a heavy hit: over 50 bridges, many part of important highways, were destroyed when the high water washed them out or carried debris and smashed them. Numerous roads and railways were also washed out.

The Holland Marsh which is located in a bowl-shaped valley directly south of Lake Simcoe, near Bradford flooded slowly giving people enough warning to escape to Bradford, located on a hill, avoiding drowning. Property damage was severe and all you could see in the distance sticking out of the water was the steeple of the Springdale Christian Reformed Church. Highway 400 was covered up to six metres in some places.

The economic losses were hard. While most of the year's crop had been harvested by mid-October, it had not been brought in, so it was either submerged or swept away by the flood. In addition, any produce that came into contact with flood was deemed to be unfit for consumption and had to be destroyed. The original effort to drain the Marsh by was unsuccessful. The pumps kept getting clogged by debris. After collecting various donations, they were able to purchase the appropriate equipment and the marsh was drained by November 13. People speculated about the possibility that the marsh would be infertile after the flood; however, in the following years they actually experienced higher than average harvests.



**Source: The Metropolitan Toronto and Region Conservation authority.**

The Humber River, in the west end of the city, caused the most destruction as a result of an intense flash flood. The resulting current was so strong that the [Toronto Star](http://en.wikipedia.org/wiki/Toronto_Star) reported that the police were told that "nothing can make it and anyone in it will be killed for sure", when referring to launching a rescue boat. That prediction came true when a team of five volunteer firefighters were killed when their fire truck was swept away as they were responding to help a stranded motorist. Communities along the Humber which were located in its floodplain were devastated: at Woodbridge, the river swelled from its usual width of 20 m to 107 m at its narrowest point, and left hundreds homeless and nine dead. Of the 81 Canadian fatalities, 35 lived on Raymore Drive. Located parallel to the river, 366 m of the road and 14 homes, many with their occupants inside, were swept away by the Humber. The rise of the river was unprecedented and the residents did not evacuate, which led to the high death toll. The damage was so severe that the area along Raymore Drive and the surrounding neighborhood which had been flooded was converted from a residential area into a park.

Further west, the Etobicoke Creek also overflowed its banks at the village of Long Branch, located near Lake Ontario, which caused heavy flooding. Seven people were killed, as many dwellings were swept into the lake. That area of the village was also converted into a park. On the east side of Toronto, areas near the Don River received some flooding, but it was not as severe due to the substantially smaller amount of rainfall in that end of the city.

Hurricane Hazel induced the most severe flooding in Toronto in over 200 years. As much of the floodplain had been developed, the flood damage was high, being estimated at $25 million ($146.9 million in 1998 dollars). Over 20 bridges were destroyed or damaged beyond repair, 81 lives lost, and 1868 families left homeless.

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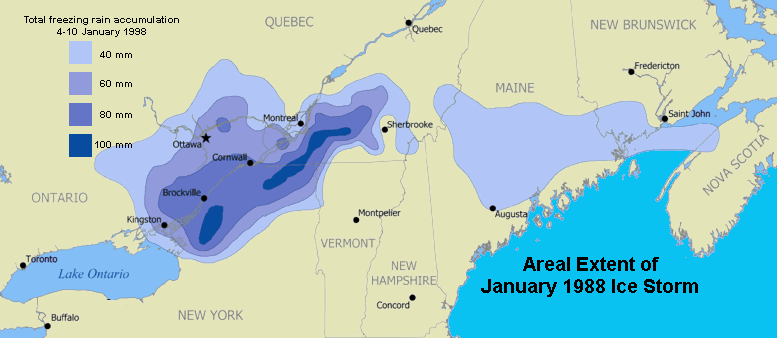
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Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Background Information Sheet #4

**Ice Storm – Ontario, Quebec, New Brunswick, 1998**

January 1998 Ontario, Quebec and New Brunswick were hit with a storm system that produced an excessive amount on freezing rain, paralyzing the provinces with power outages due to fallen trees, hydro wires, utility poles and transmission towers that left many without power for as long as a month. This disaster is classified as the most expensive natural disaster in Canada and according to Environment Canada, the ice storm of 1998 directly affected more people than any other previous weather event in Canadian history. The ice storm affected from Kitchener, Ontario through Quebec to New Brunswick and Nova Scotia. It also covered parts of New York and New England. This storm was unusual in that the freezing rain lasted more than 80 hours, while most freezing rain episodes last no more than a few hours.

Periods of freezing rain like this one may fall in any winter storm crossing eastern North America. When the fall of freezing rain persists and ice accumulates, the storm is called an ice storm that can transform roads into huge skating rinks and leave downed power lines and broken trees in their wake. However, like a heavy snow storm, the damage and inconvenience are often compensated by the beauty that the ice storm leaves in its wake.



28 people died during the ice storm, 945 people were injured, over 4 million people lost power, and about 600,000 people had to leave their homes. 130 power transmission towers were destroyed, more than 30,000 utility poles and millions of trees had fallen. The estimated cost of the ice storm is more than 5 billion dollars.

The storm began just after Christmas holidays on Monday, January 5, 1998 as a low-pressure warm front from Texas and a high pressure cold front moving in at the same time. When the air masses collided, the warm air rose, keeping the cold air down. Snow melted at mid-level; without time to freeze coming down, it froze on the ground. There was no wind to disrupt the patterns and no sun to thaw the ice between downpours causing layers of ice to build up making transportation dangerous and major power outages. At the hight of the storm 57 communities in Ontario and 200 in Quebec were declared a disaster.



**Ice Storm, 1998** - Between January 4th and 10th 1998, parts of Eastern Ontario and Western Quebec were hit by 3 successive storms that caused lengthy disruption to daily life and far-reaching economic consequences.

The ice storm had reeked havoc and by Thursday, January 8, nearly 16 000 troops were deployed to help clear debris, provide medical assistance, evacuate residents, and canvass door-to-door to make sure everyone was safe. Utility companies from all over Canada and the United States helped to restore power as quickly as they could. Most of the power to urban residents was restored within a few days. Rural residents were not so lucky and after three weeks there were still approximately 700,000 people in rural communities without power.



**Image of pedestrians walking past downed trees in Montreal by Ryan Remiorz/Canadian Press.**

The economic and geographic impact of the ice storm was tremendous. Farmers were especially hit hard with nearly a quarter of Canada’s dairy cows, a third of the crop land in Quebec and a quarter in Ontario were in the affected areas. With no power farmers were unable to milk the cows leaving them vulnerable to mastitis, an inflammation of the udder. The lack of power also resulted in farmers having to dump over 10 million litres of milk, valued at $5-6 million. The maple syrup industry took a hard hit due to the damage that the ice build up and fallen branches had sap flow and drastically reducing the number of maple syrup taps. The Ontario Maple Syrup Producers Association estimated that it could take up to 40 years for eastern Ontario's production to return to normal.

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Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Background Information Sheet #5

**The Red River Flood – Manitoba, 1979**

The Red River originates in the United Stated and flows northward into Lake Winnipeg. It is a meandering river that is flowing within a shallow stream-cut valley incised into the plain of the Red River Valley. Rivers meander, or rather twist and turn, when they are traveling on a relatively flat surface. They do this because a straight line is not the most efficient path for the water to flow. The water is swirling in various directions, mostly because of friction against the surrounding earth (the shores and the bottom of the river). It is common for the Red River to experience flooding in the spring months. The flooding is caused by an increase in the amount of water entering the river, due to factors such as a late and sudden warming during the spring, excessive snow melt and increased rainfall. These factors contribute to much of the flooding of rivers across Canada. While the flood zone of most other rivers in Canada are relatively narrow due to the confines of the river valley, the Red River flood zone is unusually broad as water spreads across the flat plain of the Red River Valley.

Winnipeg was built on the banks of the Red River and has faced disaster many times as a result flooding. Major flood occurrences: 1826 (forced the complete evacuation of the Red River colony); 1950; 1966; 1979; and again, dramatically, in 1997.

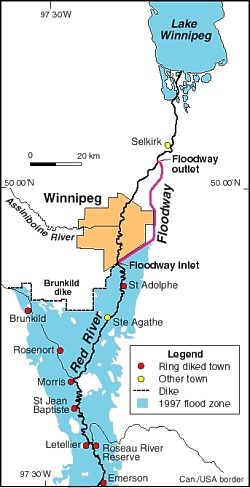
**1950 Red River Flood, Winnipeg.** 

**1979 Red River Flood, Winnipeg**

 Topic image reproduced with permission of Natural Resources Canada 2008, courtesy of the Geological Survey of Canada, photographer G.R. Brooks

**Red River Flood 1979**

Spring 1979 the Red River was threatening Winnipeg with a flood that was expected to be more severe than the flood of 1950. However, the people of Winnipeg felt secure that the floodway would protect them. In addition, they felt added security because of the ring dikes that were built in the 1970‘s around towns in southern Manitoba to protect them against flooding. Eight towns built dikes, and all eight have held up – even against the flood of 1997. While the floodway did hold and Winnipeg suffered little damage in 1979, the homes just south of the floodway were hit hard. The flood was the result of abundant snowfall and extreme temperatures. Flooding in Manitoba resulted in over [$](http://en.wikipedia.org/wiki/Canadian_dollar)500 million in damages, although the [Red River Floodway](http://en.wikipedia.org/wiki/Red_River_Floodway), an artificial waterway affectionately known as "Duff's Ditch" saved Winnipeg from flooding. This flood stimulated improvements to the flood protection system. In the end, the flood of 1979 was not worse than that of 1950. Flood levels at Winnipeg were almost identical in both years. However, flood damages were significantly lower in 1979 than they had been in 1950. In 1979, the Red River Valley was much better prepared for a flood emergency.



Map of the Red River and the central portion of the Red River Valley, Manitoba,

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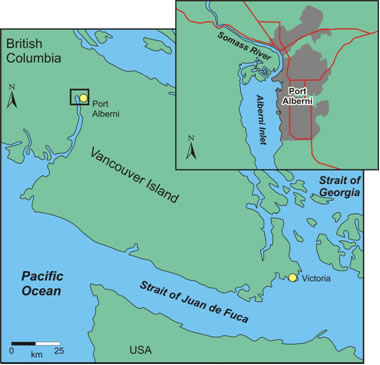
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Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Background Information Sheet #6

**Tsunami – British Columbia, 1964**

A tsunami is a sea wave or series of waves that are produced by large disturbances of the sea floor, such as an earthquake. These disturbances cause the water to move upward and the resulting wave energy to spread outward across the ocean surface at high speed. While rare in Canada, there has been one tsunami reported approximately every fifteen to twenty years in Canada since the beginning of the twentieth century. The tsunamis that have impacted Canada’s shorelines have been triggered by either an earthquake or a landslide and have had devastating impacts on the Canadian population and infrastructure.

On March 27, 1964 a tsunami was triggered after a magnitude 9.2 earthquake had occurred in Alaska. It was the largest earthquake reported for the century. The tsunami travelled to areas along the Pacific Northwest, Japan, Hawaii and Australia. In Canada, it devastated the Vancouver Island community of Port Alberni causing about $5 million in damage ($25 million in today’s dollars).

**Map of Port Alberni, West Vancouver Island**

**Source: Geological Survey of Canada**

The first wave struck the largely unsuspecting city of Port Alberni just before midnight. That 2½ metre wave was followed 90 minutes later by "a 14-foot wall of water" which picked up cars, uprooted trees and washed away entire homes. That two-storey wave was the biggest of six to hit the region over the space of seven hours. Though the waves struck at night, and without official warning, nobody was killed. Fortunately, the first wave was small, which provided residents and authorities with sufficient time to prepare for the second, larger wave. The shape and configuration of the inlet were the reason for the extensive flooding that occurred at Port Alberni. The tsunami got stronger as it funnelled through the Alberni Inlet. By the time it passed through the narrow inlet the waves reached a peak of three metres and extended some 30 kilometres inland. The first wave to reach the head of the inlet caused major flooding but was not particularly damaging. It served as a warning for people to evacuate. It was the second wave, almost an hour later, that came with much greater force and caused the greater damage by carrying homes and cars inland. It is estimated that the wave was traveling nearly 400 km/h. In the end a total of about 350 homes were damaged, with 58 being totally lost.

**Photo of tsunami effects at Port Alberni**

**Source: Geologic Survey of Canada**

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The Greatest Canadian Natural Disasters Proposal

Title of Entry: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Appropriate Data and Facts to be used:

DEPTH:

BREADTH:

DURATION:

Persuade Us (Why should this natural disaster be a part of the Guinness World Book of Records: Canadian Edition?):

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Evaluation Tool for Guinness World Book of Records Canadian Edition Entry**

#### Knowledge /5

Greatest Canadian Natural Disaster Decision Making Matrix has been

completed with attention to detail and includes relevant information.

1 2 3 4 5

### Proposal /10

Proposal is persuasive by using appropriate language, information and data

2 4 6 8 10

### Communication /15

Entry is written for specific audience with factual and relevant information.

2 4 6 8 10

Layout (included visuals) looks ready to be uses, spelling and grammar are correct

1 2 3 4 5

### Application /10

Entry is engaging and uses all of the criteria set out for an engaging page

2 4 6 8 10

TOTAL /40